ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 612296

Proj. ECN

2. ECN Category (mark one) Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. B. A. Higley, LMHC, H5-49 J. G. Field, LMHC, R2-12	4. USQ Required? [] Yes [X] No	5. Date 7/23/97
	6. Project Title/No./Work Order No. Tank 241-B-106	7. Bldg./Sys./Fac. No. NA	8. Approval Designator NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-601, Rev. 0	10. Related ECN No(s). NA	11. Related PO No. NA

12a. Modification Work [] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	12b. Work Package No. NA	12c. Modification Work Complete NA Design Authority/Cog. Engineer Signature & Date	12d. Restored to Original Condition (Temp. or Standby ECN only) NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

Add Appendix D, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-B-106.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[X]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-B-106 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

15. Distribution (include name, MSIN, and no. of copies)

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	B. A. Higley	H5-49
File	H5-49	J. M. Conner	R2-11
J. G. Field	R2-12		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

RELEASE STAMP

AUG 25 1997

DATE: HANFORD RELEASE

STA: 37 ID: 20

A-7900-013-2 (05/96) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 612296

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

Signature	Date	Signature	Date
Design Authority		Design Agent	
Cog. Eng. M. J. Kupfer M J Kupfer	7-29-97	PE	
Cog. Mgr. K. M. Hodgson K.M. Hodgson	7-30-97	QA	
QA		Safety	
Safety		Design	
Environ.		Environ.	
Other J. M. Conner J.M. Conner	7-30-97	Other	

<u>DEPARTMENT OF ENERGY</u>

Signature or a Control Number that tracks the Approval Signature

<u>ADDITIONAL</u>

Tank Characterization Report for Single-Shell Tank 241-B-106

B. A. Higley and J. G. Field
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 612296 UC: 712
Org Code: 74610 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 211

Key Words: TCR, best-basis inventory

Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-B-106 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

AUG 25 1997
DATE:
STA: 37
HANFORD RELEASE
ID: 20

Janis Bishop 8/25/97
Release Approval Date

Release Stamp

Approved for Public Release

RECORD OF REVISION

(1) Document Number	
WHC-SD-WM-ER-601	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-B-106

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released ~~3/28/96~~ gs 9/23/96 on EDT ~~615358.~~ 617524. gs	~~J. G. Field~~ gs D. J. McCain	J. G. Kristofzski
0A RS	Incorporate per ECN-612296.	M. J. Kupfer	K. M. Hodgson
		M J Kupfer 7-29-97	K.M. Hodgson 7-30-97

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-106

This page intentionally left blank.

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-106

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-B-106 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

The following evaluation provides a best-basis inventory estimate for chemical and radionuclide components in tank 241-B-106.

D1.0 CHEMICAL INFORMATION SOURCES

Characterization of tank 241-B-106 is based on two core samples obtained in 1995. A sample-based inventory (Section 4.0) was prepared based on the core sample analytical results, a measured waste density of 1.38 g/mL, and a waste volume of 443 kL (117 kgal). The Hanford Defined Waste (HDW) model (Agnew et al. 1997a) provides tank content estimates derived from process flowsheets and waste volume records.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The sample-based inventory estimates and the HDW model inventory estimates (Agnew et al. 1997a) for tank 241-B-106 are shown in Table D2-1 (The chemical species are reported without charge designation per the best-basis inventory convention). The waste solids volume used to generate both estimates is 443 kL (117 kgal). The estimates, however, use different waste densities. The sample-based inventory used a measured bulk density of 1.38 g/mL. The HDW model uses a waste density of 1.64 g/mL. The sample-based inventory is a tank layer weighted estimate rather than an estimate based on composite or averaged analytical values. Sample-based inventories and HDW model inventories will vary by 17.2 percent due to the differences in density alone.

Table D2-1. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-106.

Analyte	Sampling inventory estimate[a] (kg)	HDW model inventory estimate[b] (kg)	Analyte	Sampling inventory estimate[a] (kg)	HDW model inventory estimate[b] (kg)
Al	3,450	213	NO_3	44,400	2.37 E+05
Bi	4,350	1,650	oxalate	< 411	0.327
Ca	1,040	1,250	Pb	205	0.374
Cl	924	1,320	P as PO_4	44,100	41,300
Cr	240	128	Si	1,110	508
F	2,720	861	S as SO_4	10,100	5,550
Fe	9,150	2,880	Sr	237	0
K	<230	267	TIC as CO_3	927	4,990
La	<22	0.394	TOC	1,010	6.1
Mn	86	0.328	U_{TOTAL}	7,300	6860
Na	68,200	1.28 E+05	Zr	41	6.02
Ni	32	216	H_2O (wt%)	60.8	40.5
NO_2	4,540	4,880	Density (kg/L)	1.38	1.64

HDW = Hanford Defined Waste
[a]Section 4.0
[b]Agnew et al. (1997a).

Table D2-2. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Radioactive Components in Tank 241-B-106.[a]

Analyte	Sampling inventory estimate[b] (Ci)	HDW model inventory estimate[c] (Ci)
^{60}Co	<20	0.0244
^{90}Sr	40,000	5,460
^{99}Tc	NR	1.72
^{137}Cs	11,000	21,300
^{154}Eu	<51	0.342
^{155}Eu	<114	0.130
^{226}Ra	<752	1.06 E-07

HDW = Hanford Defined Waste
NR = Not reported
[a]Decay date for the HDW model is January 1, 1994. The sample was obtained in 1995.
[b]Section 4.0
[c]Agnew et al. (1997a).

D3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed in order to identify potential errors and/or missing information that would influence the sample-based and HDW model component inventories.

D3.1 CONTRIBUTING WASTE TYPES

Tank 241-B-106 was put into service in August 1947, as the third tank in the 241-B-104, 241-B-105, and 241-B-106 cascade. The cascade received second cycle decontamination waste (2C) from B Plant. Waste began overflowing to tank 241-B-106 in August 1947. After tank 241-B-106 was filled in May 1948, supernatant from the 241-B-104 tank cascade was pumped to cribs. In July 1950, the B Plant 2C waste was diverted to the 241-B-110 tank cascade.

Starting in the second quarter of 1952 tank 241-B-106 was designated the evaporator feed tank and began receiving first cycle decontamination waste (1C) from B Plant for concentration. Initial evaporator bottoms were concentrated 1C waste supernatant and later uranium recovery process concentrates. The 1C waste supernatants appear to have come from other tanks rather than from B Plant directly.

The current waste volumes for the tanks in the 241-B-104 tank cascade are shown in Table D3-1 (Hanlon 1997).

Table D3-1. Waste Inventory of 241-B-104, 241-B-105, and 241-B-106 Tank Cascade.[a]

Tank	241-B-104	241-B-105	241-B-106
Sludge volume (kL)	1,140	151	439
Salt cake volume (kL)	261	1,010	0
Supernatant volume (kL)	4	0	4
Drainable liquid volume (kL)	174	87	26.5

[a]Hanlon (1997).

The types of solids accumulated in tank 241-B-106 reported by various authors is compiled in Table D3-2. The Sort on Radioactive Waste Type (SORWT) model (Hill et al. 1995) indicates that the largest types of waste are 1C, followed by tri-butyl phosphate (TBP) waste from solvent based uranium recovery operations in the 1950's, Hanford Site laboratory operations waste (HLO), and a miscellaneous mixture. The HDW model only assumes the presence of B Tank Farm salt cake. This is inconsistent with the SORWT model and Hanlon (1997).

Table D3-2. Expected Solids for Tank 241-B-106.

Reference	Type
Anderson (1990)	2C, 1C, EB, TBP, TBP-HLO, TBP-BNW, BNW, 24-BNW, 224-BNW-EB-BL-IX
Historical Tank Content Estimate (Brevick et al. 1997)	BSltCk
Sort on Radioactive Waste Type model (Hill et al. 1995)	1C, TBP, HLO, MIX
Waste Status and Transaction Records Summary (Agnew et al. 1997b)	BSltCk
Hanford Defined Waste model (Agnew et al. 1997a)	BSltCk

1C = First-cycle decontamination $BiPO_4$ process waste
2C = Second-cycle decontamination BiO_4 process waste
BNW = Battelle Northwest Laboratory waste
BSltCk = B Salt Cake waste
BL = B Plant low level waste
EB = Evaporator bottoms waste
HLO = Hanford laboratory operations waste
IX = Ion exchange waste
MIX = Mixture of miscellaneous wastes
TBP = Tri-butyl phosphate.

D3.2 EVALUATION OF PROCESS FLOWSHEET INFORMATION

Since tank 241-B-106 was the third tank in a cascade, it is unlikely to have received a significant fraction of the 2C solids from B Plant. This assumption is supported by sample results which show that tank 241-B-106 has the least bismuth of the tanks in the 241-B-104 tank cascade. The wastes expected to be in this tank are primarily concentrated supernatant from 1C and TBP waste types.

Hanlon (1997) classifies the waste in tank 241-B-106 as sludge. This seems unlikely as the tank history supports the conclusion that the tank was filled with salts made by concentration of tank supernatant. Also, the sample results show large quantities of sodium, phosphate, and sulfate indicating that the waste is mostly salt cake. However, these highly concentrated salt cakes may possess sludge like characteristics.

D3.3 DOCUMENT ELEMENT BASIS

For many of the analytes, the sample-based inventory and the HDW model-based inventory were within a factor of two. Of the major analytes, Al, Bi, F, Fe, NO3, TIC, and TOC inventories based on samples and inventories based on the HDW model varied by a factor of two or more. Differences are attributed to incorrect solubility assumptions in the HDW model and bulk density differences for sample-based and HDW model based inventories.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments the number of significant figures is not increased. This charge balance approach was consistent with that used by Agnew et al. (1997a). The calculated total hydroxide inventories based on engineering assessments and HDW model estimates were 24,700 kg and 6,590 kg respectively.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

The results from this evaluation support using sampling data as the best basis for tank 241-B-106 inventory for the following reasons:

- Data from two core samples are available
- Estimates of the waste composition by flowsheet and process knowledge are uncertain since several waste types were added to the tank
- Uncertainty in flowsheet and process knowledge estimates is compounded by the effects of two preceding tanks in the cascade

The best-basis inventory estimate for tank 241-B-106 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}Pu$, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-106 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E or C)[1]	Comment
Al	3,450	S	
Bi	4,350	S	
Ca	1,040	S	
Cl	924	S	
TIC as CO_3	927	S	
Cr	240	S	
F	2,720	S	
Fe	9,150	S	
Hg	1.76	M	
K	<230	S	
La	<22	S	
Mn	86	S	
Na	68,200	S	
Ni	32	S	
NO_2	4,540	S	
NO_3	44,400	S	
OH	24,700	C	
Pb	205	S	
P as PO_4	44,100	S	
Si	1,110	S	
S as SO_4	10,100	S	
Sr	237	S	
TOC	1,010	S	

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-106 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E or C)[1]	Comment
U_{TOTAL}	7,300	S	
Zr	41	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-106, Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	1.67	M	
^{14}C	0.248	M	
^{59}Ni	0.278	M	
^{60}Co	<20	S	
^{63}Ni	25	M	
^{79}Se	0.0498	M	
^{90}Sr	5,460	M	
^{90}Y	5,470	M	
^{93m}Nb	0.199	M	
^{93}Zr	0.237	M	
^{99}Tc	1.72	M	
^{106}Ru	3.79 E-06	M	
^{113m}Cd	0.593	M	
^{125}Sb	0.157	M	
^{126}Sn	0.0748	M	
^{129}I	0.00325	M	
^{134}Cs	<28	S	
^{137m}Ba	10,400	S	Referenced to ^{137}Cs
^{137}Cs	11,000	S	
^{151}Sm	185	M	
^{152}Eu	0.0359	M	
^{154}Eu	<51	S	
^{155}Eu	<114	S	
^{226}Ra	<752	S	
^{227}Ac	7.13 E-05	M	
^{228}Ra	4.34 E-04	M	
^{229}Th	1.02 E-05	M	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-106, Decayed to January 1, 1994 (Effective May 31, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{231}Pa	1.56 E-04	M	
^{232}Th	2.85 E-05	M	
^{232}U	0.00212	M	
^{233}U	0.00793	M	
^{234}U	2.26	M	
^{235}U	0.100	M	
^{236}U	0.0211	M	
^{237}Np	0.0102	M	
^{238}Pu	0.119	M	
^{238}U	2.29	M	
^{239}Pu	21.3	M	
^{240}Pu	1.65	M	
^{241}Am	0.429	M	
^{241}Pu	4.12	M	
^{242}Cm	7.09 E-04	M	
^{242}Pu	1.83 E-05	M	
^{243}Am	3.77 E-06	M	
^{243}Cm	2.25 E-05	M	
^{244}Cm	1.41 E-04	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based.

This page intentionally left blank.

D5.0 APPENDIX D REFERENCES

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. FitzPatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997a, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model, Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

Agnew, S. F., R. A. Corbin, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997b, *Waste Status and Transaction Record Summary (WSTRS REV. 4)*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

Anderson, J. D., 1990, *A History of the 200 Area Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area*, WHC-SD-WM-ER-349, Rev. 1-B, Fluor Daniel Northwest, Richland, Washington.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending March 31, 1997*, HNF-EP-182-108, Lockheed Martin Hanford Corporation, Richland, Washington.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

Hodgson, K. M. and M. D. LeClair, 1996, *Work Plan for Defining a Standard Inventory Estimate for Wastes Stored in Hanford Site Underground Tanks*, WHC-SD-WM-WP-311, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, and R. A. Watrous (LMHC), S. L. Lambert, and D. E. Place (SESC), R. M. Orme (NHC), G. L. Borsheim (Borsheim Associates), N. G. Colton (PNNL), M. D. LeClair (SAIC), R. T. Winward (Meier Associates), and W. W. Schulz (W^2S Corporation), 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Watrous, R. A., and D. W. Wootan, 1997, *Activity of Fuel Batches Processed Through Hanford Separations Plants, 1944 Through 1989,* HNF-SD-WM-TI-794, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

This page intentionally left blank.